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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Forest Insect Laboratory
Coeur d'Alene, Idaho

Archie L. Gibson

Project h-1-17 (2) (5) Date December 1, 1942 Author Assistant Entomologist

TITLE

FALL CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE WITH PENETRATING SPRAYS 1941

SUBJECT—

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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Forest Insect Laboratory
Coeur d'Alene, Idaho

BUREAU OF
Entomology and Plant Quarantine
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☆ JAN 7 1943 ☆
FOREST INSECT LABORATORY,
PORTLAND OREGON

January 5, 1943

To: R. L. Furniss, Acting in Charge, Portland Laboratory

From: James C. Evenden, in Charge, Coeur d'Alene Laboratory

Subject: Penetrating Sprays

I wish to thank you for your recent letter commenting upon Mr. Gibson's report covering the results of fall control experiments. I note that both you and Mr. Wygant seem to question the advisability of using penetrating sprays in the fall of the year when the ground is covered with snow. I think that I concur with you in this position, and believe that we can perhaps go back properly to the method first used in the Big Hole Basin in 1926, when the trees were felled and decked for subsequent burning. If there is no snow on the ground and transportation is not too difficult a problem, then perhaps penetrating sprays would prove to be the most economical procedure.

Thank you for calling our attention to the article on page 46 of the December issue of THE TIMBERMAN relative to penetrating sprays. As you state, this article does imply that the Forest Service is the agency responsible for discovering the mixture. However, I feel that this is a mistake of the writer and that there was no intent on the part of the Forest Service to make this implication.

Again I thank you for your kindness in commenting upon Mr. Gibson's report.

Copies of this letter are being sent to Dr. Craighead and Mr. Wygant.

James C Evenden

xxxxxxxxxxxxxx

Forest Insect Laboratory
445 U. S. Court House
Portland, Oregon
December 28, 1938

To: J. C. Evenden, in Charge, Coeur d'Alene Laboratory

From: R. L. Furniss, Acting in Charge, Portland Laboratory

Subject; Gibson's report "Fall Control of the Mountain Pine Beetle in Western White Pine with Penetrating Sprays, 1941"

Mr. Gibson's success with the penetrating oil sprays almost makes us wish for an outbreak of themountain pine beetle in this region to see how our particular race of this beetle responds to this type of treatment. After seeing the large scale Wasatch project, I am completely sold on the method - at least for spring and early summer control. I am not so sure about the fall and winter work, although the results to date have been most promising. Somehow it doesn't seem quite right that water, snow, and oil is a combination that will assure fully dependable results.

Probably you have noted that on page 46 of the December issue of the Timberman considerable publicity is given to the ortho-diesel oil (1:4) mixture. In this article the Forest Service, by implication, is given credit for discovering the mixture. This seems like an oversight of the good work done by the Coeur d'Alene staff.

We were interested to learn from Gibson's report that dilution of ortho with diesel oil can be reduced from 1:4 to 1:6 without reducing effectiveness of kill. It is also encouraging that ortho emulsion still holds some promise of success.

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Noted by ...
R.L.F.

Forest Insect Laboratory
Coeur d'Alene, Idaho

December 9, 1942

To: F. C. Craighead, in Charge, Forest Insect Investigations

From: James C. Evenden, in Charge, Coeur d'Alene Laboratory

Subject: Report "Fall Control of the Mountain Pine Beetle in Western White Pine with Penetrating Sprays, 1941"

I am enclosing a copy of Mr. Gibson's report covering his experimental work on the use of penetrating sprays for fall control of the mountain pine beetle in western white pine.

This report shows that the use of penetrating sprays for the fall control of the mountain pine beetle in white pine is a feasible procedure. Even in wet logs the insect broods were destroyed with 4 parts of fuel oil to 1 part of orthodichlorobenzene. Additional experimentation indicates that the same success may be attained with a weaker solution than the 4 to 1 tested at that time.

A number of emulsions where water and an emulsifying agent were used in lieu of fuel oil as the carrier for orthodichlorobenzene were not considered successful for fall control.

Your comments concerning this report will be appreciated.

Copies of this letter and the report have been sent to Messrs. Keen, Furniss, Wygant, and Whitten.

James C. Evenden

Enclosure

FALL CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE WITH PENETRATING SPRAYS
- 1941 -

INTRODUCTION

Tests, followed by control projects, have demonstrated the effectiveness of penetrating sprays in controlling brood of the mountain pine beetle in western white pine when applied in the spring and early summer. Extension of the period during which sprays could be effectively used to late summer and fall would greatly increase the value of that method. Already tests of fall control in lodgepole pine have shown satisfactory results with certain oil-base sprays. With similar sprays, supplemented by a number of emulsions, a series of tests of fall control of the mountain pine beetle in western white pine were conducted in October of 1941 on the Yellow Dog Creek drainage of the Coeur d'Alene National Forest.

Weather conditions at the time the tests were conducted were decidedly adverse for ready absorption of sprays. While the amount of precipitation was only slightly above normal, the number of cloudy and partly cloudy days, indicative of rainy or practically non-drying weather, averaged 24 for October at Wallace and Kellogg. These two towns contain the nearest weather stations to the area on which the tests were made. Such weather resulted in the bark surface of material to be treated being wet a number of times and almost certainly retaining much of the moisture even though the surface appeared dry when treated. Moisture is believed to retard and possibly reduce the amount of spray absorption even if for no other reason than that its presence would prevent the absorption of an equal amount of oil. For the preceding reasons it is believed the results obtained with these tests may be considered a conservative estimate of the effectiveness of the sprays for a normal fall. As a measure of effectiveness an arbitrary figure of two surviving insects per square foot of treated bark surface was set as the maximum number for acceptable control.

MATERIAL AND METHOD

Mountain-pine-beetle-infested trees were felled and cut into 10-foot logs with one check log being left in each tree. Equal numbers of logs containing immature and mature stages of brood development were sought for each test, but too few of the former were available for the desired number of samples. However, the amount of bark surface sampled is believed to have been enough to give a good indication of the effectiveness of the spray against the immature brood. Only logs showing a concentration of not less than 10 mountain pine beetle brood per square foot of bark surface were selected for the tests.

The general exposure on which the test material was located was north-facing, but possibly 25 percent of the trees were on slopes more or less west- or east-facing. In general the site was cool and moist; the stand a mixture of western white pine, larch, grand fir, Douglas fir, western hemlock, and occasional cedar, lodgepole pine and Engelmann spruce. Treated material was subjected to very little, if any, direct sunlight.

It was planned with most of the tests to treat only dry logs, but the unusual weather conditions prevented that and some of the logs were more or less moist when sprayed. The logs were sprayed until the bark surface glistened and the liquid was ready to run, thus assuring a thorough coverage. Treatment was by means of a hand-pump pressure sprayer of about 3-1/2 gallons capacity. The tests were completed between October 3 and 24. Where wet logs were used that condition was obtained either by giving them a preliminary spraying with water until the bark surface glistened, or by selecting logs thoroughly soaked from rain. It is recognized that there may have been considerable difference in degree of wetness of the logs used, but conditions at the time did not permit securing more uniform samples.

After treating, the logs were left in the same position as when the tree was felled in order to duplicate as closely as possible the conditions of a control job. However, where there were indications the logs might be exposed to direct sunlight, sufficient brush was used to prevent solar killing of the bark beetle brood.

EXAMINATIONS

In examining the logs to determine effectiveness of the sprays, a band of bark was removed from the logs and the number of survivors per square foot of surface noted. If the living brood exceeded 2 to the square foot, later examinations were made to note any delayed mortality effect which the chemical may have had. Where necessary these examinations were repeated up to the time of emergence. Check logs were examined in a similar manner to reveal any unusual mortality not associated with treatment.

To compare potential emergence from untreated material with that from treated logs, three large galvanized iron cans were filled with approximately 15 square feet of infested bark surface per can and the emerging insects collected and counted.

Expecting a normal season, examinations to determine the effects of fall control were begun in late June of 1942. It was found, however, that temperatures 3° F. below normal and precipitation exceeding normal by 83 percent during June and July were probably responsible for the retarded brood development. This delayed development necessitated deferring final examinations until late July and early August.

The results from the treatments are discussed in the following pages.

Formula 1 - Oil 3
Orthene 1

Immature brood treated with this spray revealed 29 surviving insects under 24.5 square feet of bark surface on eight logs. With the exception of one larva, all survivors were found where there was no odor of spray. The reason for the absence of spray odor on some logs in this and other tests is unknown. Furthermore, nearly 2/3 of the survivors were in the larval and pupal stages and thus subject to additional mortality prior to emergence. Under the above conditions much of the survival may be considered abnormal, and the spray practically 100 percent effective against brood in the immature stages of development.

Mature brood was completely controlled in three of the four logs treated. No indication of why brood survived in the remaining log was apparent. However, as about 90 percent of the survivors were larvae and pupae, more mortality can be expected with the end result comparable to the excellent control noted against immature brood.

While highly effective this spray is expnsive at $0.25 per gallon and yields results not significantly better than other cheaper sprays.

The data from individual logs is shown in table 1.

Table 1 - Trees treated in fall of 1941 with penetrating sprays to control the mountain pine beetle in western white pine

Formula 1 (Oil 3 parts
(Orthene 1/ 1 part

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	Square feet examined
6-28	17	6	--	--	--	1.5
7-29	3	1	1	3	1	4.0 2/
"	3	4	2	5	--	4.0 2/
"	4	2	--	--	--	3.0
7-24	6	2	1	--	--	3.5
"	7	1	--	--	--	3.5
"	7	5	--	--	--	2.5
7-30	58	4	5	2	9	2.5 2/
Average date exam. 7-23			9	10	10	24.5

29

29 ÷ 24.5 = 1.2 living per sq. ft.

Logs Containing Mature Brood

Date examined in 1942	Tree No.	Log No.	Larvae	Pupae	New adults	Square feet examined
6-23	1	3	--	--	--	2.0
7-22	59	2	--	--	--	4.0
7-30	17	1	--	--	--	5.5
8-4	39	2	11	12	3	7.0 3/
Average date exam. 7-20			11	12	3	18.5

26

26 ÷ 18.5 = 1.4 living per sq. ft.

1/ Orthodichlorobenzene
2/ Survivors where no odor of spray noticeable
3/ Survivors where spray odor noticeable

Formula 2 (Oil 4
(Orthene 1

This formula, which has been tentatively adopted for control projects where penetrating sprays are used against brood of the mountain pine beetle, was tested against immature and mature brood in both dry- and wet-bark-surface logs. As there was little variation in the excellence of results, there will be no discussion of this formula other than to say that the spray was highly effective.

Apparently brood in wet logs is almost as readily controlled by this formula as in dry logs. This formula costs about $0.22 per gallon.

A feature of this treatment which was quite apparent was the rapidity of control secured, especially against the more mature insects, which was about 16 days more rapid than against immature brood. In wet logs the indicated difference was 23 days. The data from these two tests are given in tables 2 and 3.

Table 2 - Trees treated in fall of 1941 with penetrating sprays to control mountain pine beetle in western white pine

Formula 2 (Oil 4 parts
(Orthene 1 part

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	Square feet examined
7-29	5	1	--	--	--	4.0
"		3	--	--	--	3.0
7-24	6	4	4	--	--	3.0
"	7	2	--	--	--	3.0
7-30	16	4	1	--	--	3.0
7-22	38	4	--	--	--	3.5
7-14	41	3	2	--	--	4.0
7-15	45	2	--	--	--	3.5
7-15	46	2	--	--	--	4.0
Average date exam. 7-22			7			31.0

7 ÷ 31 = .22 living per sq. ft.

Logs Containing Mature Brood

6-23	10	2	--	--	--	2.5
7-29	12	2	--	--	--	3.0
6-24	11	3	--	--	--	3.0
6-24	14	2	--	--	--	3.0
6-22	39	3	--	--	--	3.0
7-14	40	1	2	--	--	5.0
7-14	42	4	--	--	--	4.5
"	43	1	--	--	--	7.0
Average date exam. 7-6			2			31.0

2 ÷ 31 = .06 living per sq. ft.

Table 3 - Wet trees treated in fall of 1941 with penetrating sprays to control mountain pine beetle in western white pine

Formula 2 (Oil 4 parts
(Orthene 1 part

Wet Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	Square feet examined
7-29	3	3	17	2	--	4.0 1/
7-29	4	1	--	--	--	5.0
"		3	--	--	--	5.0
"		5	--	--	--	3.0
7-22	15	4	--	--	--	3.0
Average date exam. 7-27			17	2		20.0

19

19 ÷ 20 = .95 living per sq. ft.

1/ No odor of spray where survivors noted.

Wet Logs Containing Mature Brood

6-23	1	4	--	--	--	2.0
7-29		5	3	2	1	6.0
6-23		6	--	--	--	2.0
6-23	9	1	--	--	--	3.5
6-26	13	1	--	--	--	3.0
"		3	--	--	--	2.0
"	14	5	--	--	--	3.0
7-30	15	1	--	1	--	4.0
Average date exam. 7-4			3	3	1	25.5

7

7 ÷ 25.5 = .27 living per sq. ft.

Formula 3 (Oil 6
(Orthene 1

The somewhat contradictory results from this treatment are due to the survival of considerable brood in one log. The presence of Hylurgops sp. indicated that this log was abnormally wet and not typical of material in which the mountain pine beetle is found. It seems quite likely tht this moisture-saturated bark prevented or greatly reduced the absorption of the spray, thus accounting for the absence of spray odor. In previous work with penetrating sprays the writer has noted that where the bark is living and more normally moist control is much slower. Control is also likely to be less effective than it is under bark that is dead and more or less dry. Under the bark of the moisture-saturated log just discussed, even greater retardation of development and less control could be expected. Because of the preceding conditions and the difficulty of distinguishing between mountain pine beetle and Hylurgops sp. larvae the data from this log are not considered typical and have been rejected.

Considering the data without those from the log just discussed, this formula gave control not significantly less than sprays having a greater concentration of orthene. As its cost of $0.19 per gallon was less than that of the more concentrated sprays, it would naturally replace them. Table 4 gives the data.

In the logs containing immature brood, control was not secured until about 12 days later than in logs containing more mature insects.

Table 4 - Trees treated in fall of 1941 with penetrating sprays

Formula 3 (Oil 6 parts
(Orthene 1 part

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	Square feet examined
7-29	3	2	13	5	2	6.0 1/
7-24	6	1	--	--	--	3.5
"	7	3	--	--	--	3.0
7-30	41	1	4	4	--	3.0
6-23	8	3	--	--	--	2.0
6-24	12	3	--	--	--	2.0
Average date exam. 7-16			17	9	2	19.5

25

25 ÷ 19.5 = 1.44 living per sq. ft.

1/ Survivors in areas having no spray odor.

Logs Containing Mature Brood

7-22	1	1	--	--	--	9.0
6-23	9	4	--	--	--	2.5
6-24	10	3	--	--	--	2.5
"	11	1	--	--	--	3.5
6-22	38	1	--	--	--	2.5
7-22	39	4	--	--	--	4.0
7-14	42	3	--	--	--	6.0
"	43	4	--	--	--	4.0
Average date exam. 7-5½			--	--	--	34.0

Complete control

DISCUSSION

The use of oil-base sprays with orthodichlorobenzene as their lethal ingredient for control of the mountain pine beetle in western white pine in the fall of the year is entirely feasible, as indicated by the results of the tests just discussed. As control with the spray containing 6 parts of oil to 1 of orthodichlorobenzene was not significantly less effective than with more concentrated and more costly sprays, the 6 to 1 mixture would naturally be and is recommended for use under weather conditions similar to those in 1941.

From the data secured for control of both immature and mature brood, the indications are that lethal action is slower on the former by about two weeks. There is also a slightly higher survival where the brood was immature at the time the logs were sprayed. As previously indicated, this is believed to be due to the slower and possibly smaller amount of spray absorbed by the wetter bark.

From the sprays tested it seems possible that acceptable fall control may be secured with even less concentration of orthodichlorobenzene. To determine this, 8 to 1 and 10 to 1 concentrations of oil and orthodichlorobenzene were tested in the fall of 1942, using for each experiment 14 logs, of which 7 contained immature brood and 7 mature brood. Tests of wet logs were also made. The data from these tests will be available in the summer of 1943.

TESTS WITH EMULSIONS

The possibility of effecting decided savings in the costs of the sprays by the use of emulsions in which the usually readily available water is substituted for the Diesel oil as a carrier indicates the desirability of exhaustive tests with that type of spray. If they could be used instead of the Diesel-oil-base sprays, the high cost of transporting the oil to the trees to be treated would be reduced to the much lower cost of transporting water from the nearest source to the point of use. For that reason tests were begun with emulsions using orthene as the lethal agent, mixing it with the water by means of various emulsifying agents.

Compared with results from oil-base sprays, emulsions were decidedly less effective. Perfect control on one log would be offset by indifferent results on the next, with average control fairly good but insufficient to be acceptable. The results and sprays tested are given in the succeeding pages.

Table 5 - Data from trees treated in the fall of 1941 with emulsions to control the mountain pine beetle in western white pine

Formula 4 (Water 3 qt.
(Orthene 1 qt.
(Oleic acid 127 cc.
(Triethanolamine 75 cc.

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults		Square feet examined
7-22	46	6	13	--	--		4.0
8-21	46	1	11	5	5		3.0
7-22	17	5	19	2	--		4.0
7-24	17	2	27	10	--		2.0
7-15	45	4	--	--	--		4.0
Average date exam. 7-23			70	17	5		17.0
				92			

92 ÷ 17 = 5.4 living per sq. ft.

Logs Containing Mature Brood

						E.H. 1/	
7-22	16	1	32	8	4		4.0
8-21	44	2	3	--	3	1	5.0
7-22	58	1	22	11	7		2.0
"	59	3	4	1	--		4.0
"	60	2	9	1	--		4.0
Average date exam. 7-28			70	21	14	E.H. 1	19.0
				106			

106 ÷ 19 = 5.6 living per sq. ft.

1/ New adult emergence holes

With an average brood survival of 5.5 per square foot for the two general divisions of brood status it is seen that in spite of good control, survival per square foot is still too high.

Table 6 - Data from trees treated in the fall of 1941 with emulsions to control the mountain pine beetle in western white pine

Formula 5	(Water	3 qt.
	(Orthene	1 qt.
	(Oleic acid	2 oz.
	(Triethanolamine	20 cc.

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	Square feet examined
8-21	14	6	3	--	5	1.5
			8			

8 ÷ 1.5 = 5.3 living per sq. ft.

Logs Containing Mature Brood

6-24	14	1	--	--	--	2.0
8-21		4	5	--	4	2.0
7-22	15	2	1	10	17	3.0
Average date exam. 7-23			6	10	21	7.0
				37		

37 ÷ 7.0 = 5.3 living per sq. ft.

Results obtained with this spray were quite similar to those from the preceding experiment.

Table 7 - Data from trees tested in the fall of 1941 with emulsions to control the mountain pine beetle in western white pine

Formula 6	(Water	4 qt.
	(Orthene	1 qt.
	(Oleic acid	127 cc.
	(Triethanolamine	75 cc.

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults	N.A.E.H.	Square feet examined
7-22	17	7	--	--	--		2.0
"	44	1	20	9	2		2.0
8-4	17	4	15	2	--		1.0
8-22	46	3	6	5	1	1	5.0
"	46	5	7	1	--	1	2.0
Average date exam. 8-6			48	17	3	2	12.0

70

70 ÷ 12 = 5.8 living per sq. ft.

Logs Containing Mature Brood

7-22	45	3	7	--	--		5.0
"	59	4	6	5	10		3.0
"	60	1	--	--	--		3.0
8-4	16	3	5	16	20		1.5
"	58	3	4	1	5		3.0
Average date examined 7-27			22	22	35		15.5

79

79 ÷ 15.5 = 5.1 living per sq. ft.

This emulsion also proved ineffective.

Table 8 - Data from trees tested in the fall of 1941 with emulsions to control the mountain pine beetle in western white pine

Formula 7 (Water 4 qt., Orthene 1 qt., Triton 720 200 cc.)

Logs Containing Immature Brood

Date examined in 1942	Tree No.	Log No.	Living brood: Larvae	Pupae	New adults		Square feet examined
6-24	10	4	--	--	--		2.0
8-21	42	2	--	--	1	4 N.H.	5.0
"	8	1	2	4	14		2.0
7-14	40	3	6	--	--		6.0
Average date exam. 7-28			8	4	15	4	15.0

31

31 ÷ 15 = 2.1 per sq. ft.

Logs Containing Mature Brood

						N.H.	
8-21	9	3	3	1	6	1	3.5
8-21	11	2	3	--	14	16	2.5
"		5	4	1	10	2	5.0
"	12	1	--	2	9		1.0
"		4	1	2	23	1	1.0
7-22	38	2	9	24	12		3.5
8-21	43	3	--	1	9	3	1.5
Average date exam. 8-13			20	31	83	23	18.0

157

157 ÷ 18 = 8.7

188 ÷ 33 = 5.7 per sq. ft.

This emulsion also proved ineffective.

The four emulsions all proved ineffective insofar as giving adequate control is concerned, but the final survival figure per square foot was surprisingly close. High mortality was caused by all of the emulsions, but erratic results were obtained with each of them, ranging from complete control in a few logs to a high percent of survival in others. The reason for this is not apparent. Because of too high survival, no further tests with these sprays are contemplated, but the possibility that other emulsions may prove effective indicates the need for more work in this field.

Limiting of the figure for acceptable survival of treated material to a maximum of two insects per square foot, while satisfactory for the purpose intended, gives little idea of the percent of control caused by the sprays. To obtain such data, infested, untreated logs were placed in galvanized iron cans and emerging insects trapped and counted. The infested material was from a tree believed to have been attacked in July of 1941, judging by the brood development. Average emergence per square foot of bark surface in the untreated material seems higher than normal, but this may have been due to protection of the brood from parasites and predators which would normally attack the brood during the period enclosed in the cans. The comparative effectiveness of the sprays may be visualized from a study of table 8, which contains the condensed data from the various treatments and from the untreated logs.

To approach the problem of emergence from another angle, six Buckhorn type cages were placed on four infested trees. These cages covered approximately six square feet of bark surface each on a portion of the tree from 2 to 6 feet above the ground. There is a possibility that emergence from these trees was not complete in 1942. Up to late October of 1942 it had been quite variable not only between trees but even on opposite sides of the same tree. The following tabulation gives the data.

Table 5 - Condensed data from each test and from untreated material

Oil-base sprays

Formula	Average date treated	Living brood per sq. ft. Lar.	Pup.	N.A.	Total	Sq.ft. exam.	Brood stage when treated	
Oil 3 parts Orthene 1 part	7-23	.4	.4	.4	1.2	24.5	Immature	
"	7-20	.6	.6	.2	1.4	18.5	Mature	
Oil 4 parts Orthene 1 part	7-22	.2	--	--	.2	31.0	Immature	
"	7-6	.05	--	--	.05	31.0	Mature	
Oil 4 parts Orthene 1 part	7-27	.9	.1	--	1.0	20.0	Immature	Wet logs
"	7-4	.1	.1	.05	.25	25.5	Mature	" "
Oil 6 parts Orthene 1 part	7-16	.85	.5	.1	1.45	19.5	Immature	
"	7-5	--	--	--	--	34.0	Mature	

Emulsions

Water 3 qt. Orthene 1 qt. Oleic acid 127 cc. Triethan-olamine 75 cc.	7-23	4.1	1.0	.3	5.4	17.0	Immature
	7-28	3.7	1.1	.9	5.6	19.0	Mature
Water 3 qt. Orthene 1 qt. Oleic acid 2 oz. Triethan-olamine 20 cc.	8-21	2.0	--	3.3	5.3	1.5	Immature
	7-22	.9	1.4	3.0	5.3	7.0	Mature
Water 4 qt. Orthene 1 qt. Oleic acid 127 cc. Triethan-olamine 75 cc.	8-6	4.0	1.4	.4	5.8	12.0	Immature
	7-27	1.4	1.4	2.3	5.1	15.5	Mature
Water 4 qt. Orthene 1 qt. Triton #720 200 cc.	7-28	.5	.3	1.3	2.1	15.0	Immature
	7-17	1.1	1.7	5.9	8.7	18.0	Mature

Untreated material

Untreated	Emergence new adults				97.1	97.1	45.0

Emergence of Mountain Pine Beetle from
Western White Pine as Indicated by Buckhorn Cages
1942

Tree number	1	2	3 1/		4 1/	
Cage number	1	2	3	4	5	6
Brood emergence per square foot	11.3	3.0	31.8	33.2	16.8	8.2

Average emergence from six cages = 17.3 per sq. ft.

1/ Two cages on each of trees 3 and 4.

The preceding tabulation indicates that emergence from this type of cage is decidedly less than from the galvanized iron cans. Not knowing what data are representative of the true emergence, the average from the five trees is used and found to be 32.1 per square foot. On that basis the highest possible survival from the material treated with oil-base sprays is about 4.5 percent, which is excellent control. With emulsions the average survival is approximately 17 percent, which is insufficient control to be acceptable.

CONCLUSIONS

Oil-base sprays tested gave effective control with the lowest concentration of orthene as well as those having more of the lethal ingredient. Even with the one "wet log" treatment, results were not significantly different from control in dry logs with the same spray. Even less orthene per gallon of spray should be tried, both on dry and wet logs. Tests with wet logs are for the purpose of determining what influence, if any, wet weather may have on the effectiveness of control.

Control was not sufficiently good with emulsions to warrant recommending them, but they did give encouraging results. A somewhat surprising result was the uniformity of survival, which in six of the eight tests with emulsions was slightly over 5 insects per square foot of bark surface.

Because of the decided reduction in control costs that may be possible by the use of emulsions, further tests with them should be considered whenever a promising spray is developed.

SUMMARY

Use of penetrating sprays for control of the mountain pine beetle in western white pine in the fall of the year would greatly extend the usefulness of the method. It was for the above reason that a few tests with oil-base sprays and emulsions were made in the fall of 1941. Results from these tests indicate successful control can be expected with oil-base sprays in the fall on wet as well as on dry logs. Comparison on a percentage basis of living brood in logs treated with oil-base sprays and in untreated material indicates a potential survival of not over 4.5 percent, which is excellent control. A similar comparison with material treated with emulsions indicates about 17 percent of the brood surviving, which is too high to be acceptable.

Results indicate that even weaker concentrations of orthene in oil than the 6 to 1 mixture may prove successful. Tests of such sprays were made in the fall of 1942. Further tests with emulsions are also suggested due to the possibility of decided reduction in control costs if an effective mixture can be found.